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MuChin: A Chinese Colloquial Description Benchmark for Evaluating Language Models in the Field of Music

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Abstract

The rapidly evolving multimodal Large Language Models (LLMs) urgently require new benchmarks to uniformly evaluate their performance on understanding and textually describing music. However, due to semantic gaps between Music Information Retrieval (MIR) algorithms and human understanding, discrepancies between professionals and the public, and low precision of annotations, existing music description datasets cannot serve as benchmarks. To this end, we present MuChin, the first open-source music description benchmark in Chinese colloquial language, designed to evaluate the performance of multimodal LLMs in understanding and describing music. We established the Caichong Music Annotation Platform (CaiMAP) that employs an innovative multi-person, multi-stage assurance method, and recruited both amateurs and professionals to ensure the precision of annotations and alignment with popular semantics. Utilizing this method, we built a dataset with multi-dimensional, high-precision music annotations, the Caichong Music Dataset (CaiMD), and carefully selected 1,000 high-quality entries to serve as the test set for MuChin. Based on MuChin, we analyzed the discrepancies between professionals and amateurs in terms of music description, and empirically demonstrated the effectiveness of annotated data for fine-tuning LLMs. Ultimately, we employed MuChin to evaluate existing music understanding models on their ability to provide colloquial descriptions of music.

1 Introduction

As Large Language Models (LLMs) have rapidly advanced, a multitude of LLMs have achieved notable results across various domains [Zhao *et al.*, 2023] and require comprehensive evaluation across benchmarks in different fields [Liang *et al.*, 2022; Huang *et al.*, 2023b; Chang *et al.*, 2023]. Thus, the advancement of LLMs and multimodal technologies necessitates the establishment of benchmarks within the field of music for a unified evaluation. Although benchmarks currently exist for evaluating music understanding models, such as MARBLE [Yuan *et al.*, 2023], which utilizes accuracy on downstream Music Information Retrieval (MIR) tasks as its metric, this does not comprehensively evaluate the capabilities of multimodal large language models.

Music description plays a crucial role in both music understanding [Manco *et al.*, 2021; Gardner *et al.*, 2023] and text-controlled music generation [Agostinelli *et al.*, 2023; Copet *et al.*, 2023]. However, there is currently a lack of benchmarks specifically for colloquial music description, which is why we introduce MuChin, the first open-source benchmark for Chinese colloquial music description, with details provided in Figure 1.

As models for music understanding [Castellon *et al.*, 2021; Li *et al.*, 2023] and music generation [Zhang *et al.*, 2023; Wang *et al.*, 2023] have evolved, numerous datasets have been proposed, including those derived from Music Information Retrieval (MIR) algorithms or LLMs [Bertin-Mahieux *et al.*, 2011; Wang *et al.*, 2020; Lu *et al.*, 2023; Huang *et al.*, 2023a; Melechovsky *et al.*, 2023] as well as manually annotated datasets [Yang *et al.*, 2017; Bogdanov *et al.*, 2019; Schneider *et al.*, 2023; Zhu *et al.*, 2023; Wang *et al.*, 2022; Agostinelli *et al.*, 2023]. However, these datasets present certain issues that prevent them from serving as comprehensive benchmarks to thoroughly evaluate models' performance in understanding and describing music. Firstly, there is a considerable semantic gap between datasets obtained through algorithms and complex human descriptions. Secondly, current datasets annotated manually are confined to expert annotations and limited descriptive scopes, which significantly diverge from the descriptions provided by the general public [Amer *et al.*, 2013; Mikutta *et al.*, 2014]. And a detailed discussion will be presented in Section 4.1. Thirdly, due to limitations in algorithms' performance, datasets generated by MIR cannot achieve complete accuracy, and existing manually annotated datasets, where each entry is annotated by only one person, can also be prone to inaccuracies caused by human errors or biases.

To tackle these challenges, we need to engage both professionals and amateurs in annotating music. This approach will yield two distinct types of music descriptions: one, from professionals, will be rich in technical musical terms, while the other, from amateurs, will resonate with the general public's

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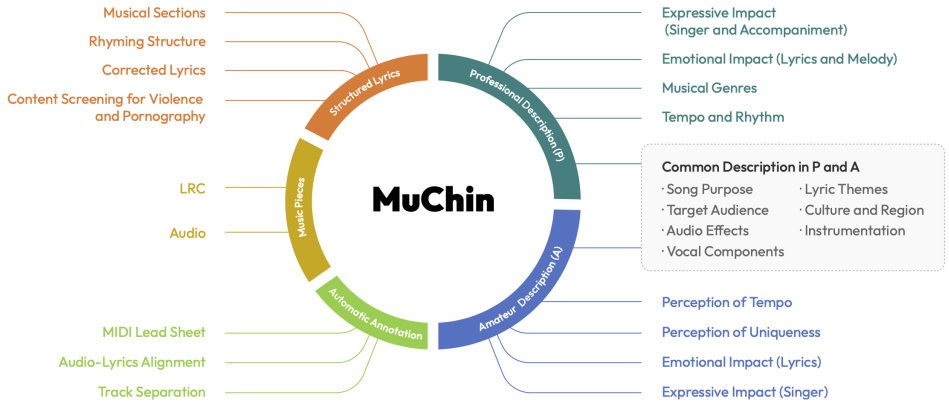

Figure 1: An overview of the MuChin benchmark. The Chinese Colloquial Descriptions consist of Description(A) and Common Description(P & A) annotated by amateur annotators. In addition, we recruit professional annotators to label Description(P), Musical Sections, and Rhyming Structures of the lyrics. And machine-annotated information such as MIDI is also incorporated. These enable MuChin to adapt to a wider range of benchmark tasks.

everyday language. Furthermore, we have introduced a sophisticated, multi-tiered quality assurance process involving multiple individuals at various phases to guarantee the precision of these annotations.

Building on this design, we created a platform that recommends widely-used music descriptors from the internet or specialized terms from the music industry, depending on the input from the annotator. This feature enables annotators to swiftly locate the precise descriptions they need. Additionally, the platform's backend employs a multi-layered, multi-person quality assurance process to verify the precision of the annotations. This approach enhances the efficiency, precision, and uniformity of the annotators' descriptions and ensures relevance to the general public by sourcing descriptive terms directly from the web.

With this platform, we have developed a comprehensive, highly accurate, and public-aligned dataset, the Caichong Music Dataset (CaiMD). From this extensive collection, we meticulously selected 1,000 high-quality entries to serve as a test set, thereby establishing a benchmark for evaluating language models' capabilities in both generating and understanding music-related tasks. Given the precision of these annotated entries, they are also exceptionally suited for fine-tuning pre-trained large language models (LLMs) for a variety of music-related downstream tasks. To illustrate this point, we have fine-tuned an LLM with an additional dataset, thereby demonstrating its efficacy.

MuChin provides a new perspective on the performance of language models in the field of music, requiring the model not only to extract basic attributes from music and describe it from a professional point of view, but also to be able to align with the musical feelings of public users, and describe music in a popular way. All data related to the benchmark, along with the scoring code and detailed appendices, have been open-sourced[1].

Our Contributions are:

1. We proposed and open-sourced MuChin: the first Chinese colloquial music description benchmark designed to more comprehensively assess the capabilities of multimodal LLMs in the field of music. Utilizing this benchmark, we evaluated the performance of existing music understanding models in terms of their ability to describe music colloquially, as well as the proficiency of current LLMs in generating structured lyrics.
2. We created the Caichong Music Annotation Platform (CaiMAP), implementing a multi-person, multi-stage quality assurance process to guarantee the precision and uniformity of annotations. This approach successfully facilitates efficient annotation of both professional and colloquial music descriptions, including musical sections and rhymes.
3. We built the Caichong Music Dataset (CaiMD): a dataset that is multi-dimensional and high-precision, aligned with the public. It contains music annotations encompassing information on both professional and colloquial descriptions. Through empirical studies, we demonstrated the effectiveness of the CaiMD on fine-tuning LLMs. Furthermore, we analyzed and verified the discrepancies between professionals and amateurs in terms of music understanding and description.

2 Related Work

Datasets Based on MIR Algorithms. Datasets based on MIR algorithms employ existing MIR algorithms to extract musical attributes from symbolic music or music audio. And then the attributes are either incorporated into complete descriptive texts or regarded as descriptive tags. MSD [Bertin-Mahieux *et al.*, 2011] collects a million of music data, along with audio, MIDI, and tags retrieved by Echo Nest Analyze API[2] (MIR toolkit). POP909 [Wang *et al.*, 2020] presents a dataset containing audio, lead sheets, and other music attributes like keys and beats. MuseCoco [Lu *et al.*, 2023] and Mustango [Melechovsky *et al.*, 2023] extract features from the original audio and then utilize ChatGPT to incorporate them as descriptions. MuLaMCap in Noise2Music [Huang

[1]https://github.com/CarlWangChina/MuChin/

[2]https://developer.spotify.com/

et al., 2023a] utilizes an LLM to generate a set of music descriptive texts, and then employs MuLan [Huang *et al.*, 2022], a text-music embedding model to match these texts with the music audio in the datasets.

Datasets Based on Manual Annotation. Some datasets based on manual annotations collect descriptions or tags from music websites, while others include data annotated by professional musicians. Hooktheory[3] is a music website where users upload audio with their annotations such as melodies, chords, and beats. MTG [Bogdanov *et al.*, 2019] and Môusai [Schneider *et al.*, 2023] use corresponding tags of music on music websites as descriptive tags, while ERNIE-Music [Zhu *et al.*, 2023] uses comments of music as music descriptions, and establish datasets upon these. Musiclm [Agostinelli *et al.*, 2023] presents a dataset, MusicCaps, including music descriptions annotated by professional musicians.

Existing Benchmarks in the Field of Music. There are several benchmarks for specific domains in the field of music. Sheet Sage [Donahue and Liang, 2021] presents a benchmark for melody transcription. GTZAN [Tzanetakis *et al.*, 2001] presents a test set for music genre classification. PMEmo [Zhang *et al.*, 2018] has collected music emotional annotations and simultaneous electrodermal activity signals for 794 songs, thereby providing a benchmark for music emotion recognition. MARBLE [Yuan *et al.*, 2023] is a comprehensive benchmark for music understanding models on 4 levels of downstream MIR tasks. However, there is a lack of comprehensive benchmarks focusing on colloquial music description.

3 Establishment of MuChin Benchmark

To bridge the gap in benchmarks for language models within the domain of music, specifically targeting Chinese colloquial expressions, we curated and constructed an annotated dataset. This effort led to the creation of the MuChin benchmark.

3.1 Benchmark Tasks

To assess LLMs across multiple dimensions, we included a variety of tasks in our dataset, leading to the creation of MuChin, which is based on the following tasks.

Textual Description Task

Textual descriptions of music involve multi-dimensional representations, including auditory perception, emotions, and music classification. Annotators are required to label and write textual descriptions. Such annotated data sets the stage for benchmarking the ability of multimodal LLMs in understanding music, particularly in tasks like music emotion recognition and classification. Moreover, this data facilitates the evaluation of LLMs' capacity in processing descriptive music texts. Additionally, it can be used to fine-tune LLMs with music-related content.

When annotating textual descriptions, annotators are required to describe music from various aspects, as shown in Figure 1. To enhance the efficiency, precision, and consistency of annotations, and to align with the public, we built lexicons of music descriptive terms, including a popular term lexicon and a professional term lexicon. The former consists of popular music descriptive terms collected from the internet, while the latter contains keywords extracted from the descriptions of the open-source text-music dataset MusicCaps [Agostinelli *et al.*, 2023]. Annotators have the option to choose appropriate terms from an existing lexicon or, if they find the terms in the lexicon unsatisfactory, they can enhance the descriptions with their own contributions.

Lyric Generation Task

Lyric generation stands as a notable use case for LLMs within the music industry, requiring LLMs to have a profound comprehension of musical structures in order to produce well-organized lyrics. To facilitate this, we construct our dataset to include information on lyric structure, thereby setting a benchmark for assessing LLMs' proficiency in generating lyrics with clear structural distinctions. This involves meticulously defining each section of the lyrics.

Additionally, the ability of LLMs to generate lyrics that align with the theme and rhyme is also crucial. Thus, annotators are required to annotate the main themes and rhymes, as well as to correct any textual errors within the lyrics.

Tasks with Automatic Annotation

Tasks with automatic annotation are discussed in Appendix A.

3.2 Preparation and Settings

For the benchmark tasks delineated in Section 3.1, it is essential to annotate the data across the corresponding dimensions. Therefore, in this section, we will undertake data preprocessing, along with the recruitment and training of individuals, aiming to secure thorough and high-precision annotations.

Data preprocessing, including **music genre clustering**, **track separation**, **audio-lyrics alignment**, and **automatic pre-annotation** is provided in Appendix B.

Recruitment and Training of Individuals

To annotate music using both amateur and professional descriptions, it is necessary to engage amateur music enthusiasts for annotating music with popular terms, and professionals – including music students and practitioners – as specialized annotators and quality assurance inspectors. Following this approach, we have recruited 213 individuals familiar with Chinese music through campus and public recruitment efforts. This group includes 109 amateur music enthusiasts and 104 professionals, consisting of 144 males and 69 females, with ages ranging from 19 to 35 years. We have organized these participants into four groups, each assigned specific tasks as follows:

- **Professional Group.** Annotate structures, rhymes and provide professional descriptions.
- **Amateur Group.** Provide colloquial descriptions.
- **Inspector Group.** Evaluate structure annotations, and score music descriptions.

[3]https://www.hooktheory.com/

- **Administrator.** Address and provide feedback on inquiries from various groups, and conduct random spot-checks of the groups' outcomes.

The **grouping** and **training method** for each group of individuals are detailed in the Appendix E.

3.3 Annotation and Assurance Pipeline

The subsequent phase involves annotation. We have devised an innovative multi-person, multi-stage assurance method aimed at improving quality of annotations and maximizing their accuracy. Additionally, this method serves to objectively evaluate the performance of annotators. Based on this method, we developed the **Caichong Music Annotation Platform (CaiMAP)**, which is introduced in Appendix D. The specific annotation pipeline is shown as Figure 2 and will be introduced in this section.

Screening & Structure Annotation Phase

In the screening phase, annotators are required to screen the data carefully. Music pieces with poor audio quality or content involving pornography or violence that are unsuitable for the dataset should be skipped.

In the structure annotation phase, the platform presents the complete lyrics sentence by sentence, and annotators are required to insert musical section tags between the lyrics. Annotators are also required to check the accuracy of the pre-annotated phonemes and rhymes for each line. If any inaccuracies are found, they should provide their own annotations.

Structure Quality Assurance Phase

To ensure the accuracy of the annotations, we implemented a quality assurance mechanism. Each piece of data undergoes annotation by two separate annotators. Subsequently, the platform autonomously verifies the congruence of the annotations. If they align, the platform seamlessly integrates the data into the dataset for the subsequent phase. In instances of disparities, both sets of annotations are referred to a quality assurance inspector for resolution. The inspector determines the correct annotation or submits an independent correction if necessary.

Description Annotation Phase

Data that successfully clears the structure quality assurance phase becomes eligible for utilization in the music description phase. During this phase, to guarantee attentive listening and thoughtful music descriptions, annotators must listen to each music piece without interruption. Specifically, annotators are prohibited from writing any textual descriptions within the initial 30 seconds of the music piece. Copy and paste content is also not allowed. Additionally, limitations are imposed on the number of tags that can be entered and on the word count of user-generated entries.

Description Quality Assurance Phase

Since music description annotation involves subjective judgments and is challenging to assess, the platform employs a randomized selection process, choosing 20% of the annotation results from each annotator for submission to quality assurance inspectors for scoring. These scores are then logged in the platform's backend. Annotated data that successfully pass the sampling quality assurance are submitted into the dataset, whereas those that do not meet the standards are rejected.

Admin Spot-Check & Settlement Phase

Administrators can monitor the real-time progress of each group's work and make payments accordingly, depending on the outcomes of quality assurance checks. Annotators who consistently achieve high pass rates for their annotations will be rewarded additionally, whereas those with lower pass rates will incur penalties, thus motivating them to annotate diligently.

To determine whether the inspectors are competent in their work, administrators also have the access to randomly selected samples of their work for secondary verification.

All the qualified annotated data are incorporated into the **CaiMD**. We provide the subsequent **data processing procedures**, **examples**, and an **overview** in Appendix F.

4 Experiments

In this section, we will begin by examining the disparities between professionals and amateurs, thereby underscoring the importance of alignment with public perception. Following that, we will choose several recent language models as benchmarks, encompassing both generative language and music comprehension models. We will then assess their ability to comprehend music, understand musical descriptions, and perform downstream tasks. Through these experiments, our goal is to evaluate the effectiveness of recent language models in the realm of music and to demonstrate our benchmarking approach.

4.1 Discrepancies Between Professionals and Amateurs

To illustrate the substantial disparity between the comprehension and description of music by professionals and amateurs, highlighting the inability of professional descriptions to resonate with the public, we conducted an experiment to gauge the differences in how these two groups articulate various musical attributes across various dimensions.

Analysis Metrics

When a specific type of musical attributes is selected, we calculate the semantic similarity between professionals and amateurs across various dimensions, utilizing the **Semantic Similarity Score** metric which will be detailed in Section 4.3.

Results

The results of the discrepancies between professionals and amateurs across various dimensions are as Figure 3.

From Figure 3(a), it is evident that there is minimal variance in the multidimensional descriptions of most music genres between the two groups. However, notable disparities arise in their perception of expression in Jazz and Rock, implying significant differences in understanding and describing of expression within progressive genres between professionals and amateurs.

From Figure 3(b), a greater discrepancy between professionals and amateurs is apparent in their interpretations of

Figure 2: Pipeline of data annotation and assurance. Each annotated data undergoes 5 complex phases to ensure the accuracy. The figure shows the actual screenshots of the pages for each phase. For **software development** and **operation** details please refer to Appendix D

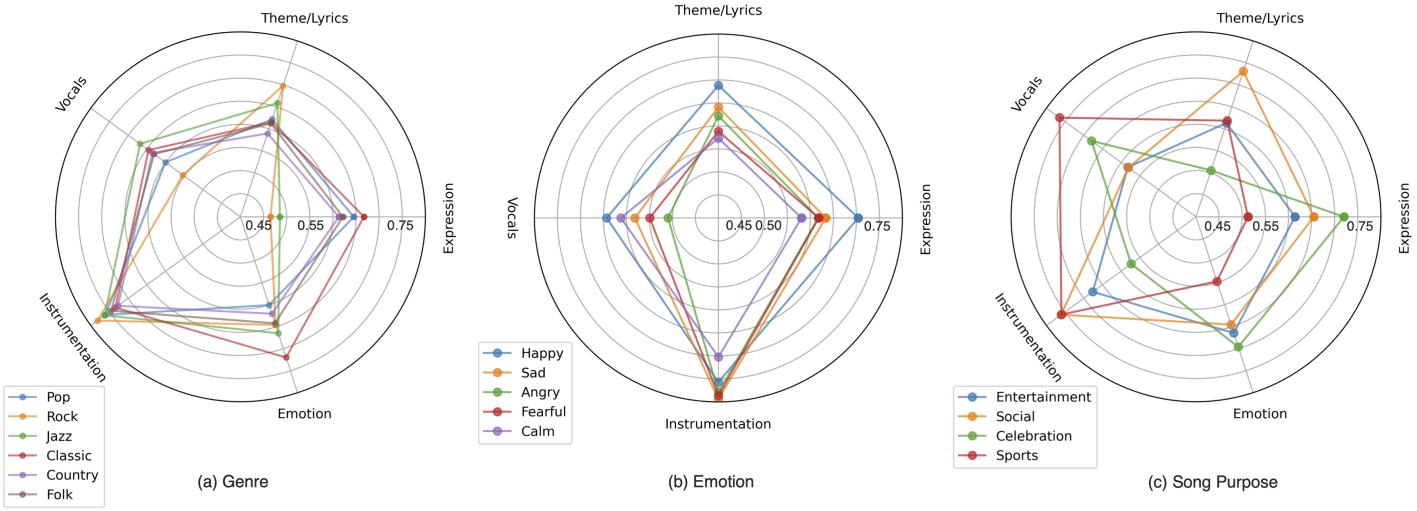

Figure 3: Semantic similarity scores between professionals and amateurs. When a specific type of music is selected, we calculate the similarity between the two groups in various dimensions, for which the **calculation method** is discussed in Section 4.3. As a **smaller** value signifies a **larger discrepancy**, the experimental results in this figure reveal significant gaps between the two groups across several specific dimensions.

music pieces evoking calm and angry emotions, in contrast to those evoking happiness. This underscores the impact of emotions on the comprehension divide between the two groups.

Figure 3(c) reveals substantial disparities in the semantic similarity distribution across various song purposes. This discrepancy suggests that professionals and amateurs have distinct dimensional understandings of music tailored to different intents.

Considering these findings, it becomes evident that professionals and amateurs exhibit varying levels of interpretative disparities across diverse dimensions and music types. Therefore, a comprehensive music description benchmark should accommodate both groups' perspectives.

4.2 Generative LLMs

We utilize MuChin to evaluate existing LLMs in structured lyric generation, including Qwen [Bai *et al.*, 2023], Baichuan-2 [Baichuan, 2023], GLM-130B [Zeng *et al.*, 2022], and GPT-4 [Achiam *et al.*, 2023]. Moreover, taking into account that Qwen is primarily trained on a Chinese corpus and excels in Chinese language environments, we further refined Qwen by fine-tuning it with another batch of data. Subsequently, we evaluated the performance of this fine-tuned Qwen model on MuChin to assess both the efficacy of the data in fine-tuning language and music models, as well as the fine-tuned model's proficiency in comprehending music descriptions and executing associated tasks.

Evaluation Metrics

In assessing the performance of LLMs, we prompt them with music description inputs, asking for structured lyrics along with musical sections and rhymes. While the lyrical content should present subjective diversity, the structural integrity remains objective. Hence, our evaluation primarily centers on the accuracy of the lyric structure rather than its content. We introduce an evaluation method that measures the likeness between the model-generated lyrics and the ground truth across six dimensions outlined below.

- **Song Level.** Song structure similarity measures the similarity between the generated lyrics and the ground truth in terms of overall structure.
- **Section Level.** Section structure similarity measures the similarity between the generated lyrics and the ground truth in terms of musical section labels, order, and the number of sections.
- **Phrase Level.** Phrase structure similarity measures the similarity in the number of phrases within each musical section compared to the ground truth.
- **Word Level.** Word structure similarity measures the similarity between the generated lyrics and the ground

Model		Jukebox	MERT-330M	MERT-95M	Music2Vec	EnCodec
Parameter Size		5B	330M	95M	95M	56M
Data (h)		60 ∼ 120k	160k	17k	1k	1k
Professional Description	Average Score-P	0.5490(±0.1458)	0.5586(±0.1433)	**0.5640(±0.1425)**	0.5474(±0.1417)	0.4583(±0.1377)
	Tempo & Rhythm	0.4610(±0.1016)	**0.4650(±0.1013)**	0.4607(±0.0958)	0.4604(±0.1026)	0.4587(±0.1092)
	Emo. Impact (L & M)	0.5312(±0.0939)	0.5350(±0.0903)	**0.5396(±0.0857)**	0.5311(±0.0924)	0.4860(±0.0920)
	Cult. & Reg.	0.5166(±0.2107)	0.5340(±0.2139)	**0.5390(±0.2110)**	0.5120(±0.2094)	0.4072(±0.1261)
	Vocal Components	0.5464(±0.1953)	0.5550(±0.1957)	**0.5713(±0.1989)**	0.5356(±0.1926)	0.4230(±0.1361)
	Song Purp.	0.5810(±0.2191)	0.5864(±0.2166)	**0.6040(±0.2230)**	0.5664(±0.2144)	0.4630(±0.1504)
	Mus. Genres	0.4600(±0.1239)	0.4644(±0.1172)	**0.4692(±0.1158)**	0.4610(±0.1207)	0.4297(±0.1219)
	Exp. Impact (S & A)	0.9146(±0.0541)	0.9280(±0.0476)	**0.9310(±0.0447)**	0.9190(±0.0576)	0.7085(±0.2888)
	Tgt. Aud.	0.4521(±0.1471)	0.4656(±0.1459)	**0.4683(±0.1417)**	0.4565(±0.1514)	0.3623(±0.0980)
	Instrum.	0.5083(±0.1647)	**0.5180(±0.1587)**	0.5156(±0.1592)	0.5063(±0.1727)	0.4043(±0.1426)
	Audio Eff.	0.5195(±0.1476)	0.5356(±0.1458)	**0.5425(±0.1483)**	0.5244(±0.1539)	0.4404(±0.1122)
Amateur Description	Average Score-A	0.5894(±0.1353)	0.5900(±0.1284)	**0.5923(±0.1284)**	0.5770(±0.1417)	0.4602(±0.1449)
	Perc. of Tempo	**0.4600(±0.1521)**	0.4540(±0.1475)	0.4580(±0.1456)	0.4463(±0.1407)	0.4065(±0.0994)
	Emo. Impact (L)	0.5977(±0.1780)	0.5894(±0.1798)	**0.6006(±0.1780)**	0.5806(±0.1827)	0.4430(±0.1320)
	Cult.& Reg.	0.4565(±0.1013)	0.4539(±0.0975)	**0.4575(±0.0949)**	0.4510(±0.1023)	0.4324(±0.0972)
	Vocal Components	**0.5195(±0.1208)**	0.5190(±0.1216)	0.5186(±0.1227)	0.5117(±0.12 00)	0.4795(±0.0950)
	Song Purp.	0.5240(±0.2377)	0.5210(±0.2356)	**0.5410(±0.2422)**	0.5201(±0.2428)	0.3801(±0.1532)
	Perc. of Uniq.	0.5356(±0.2076)	0.5356(±0.2115)	**0.5547(±0.2085)**	0.5060(±0.1942)	0.4130(±0.1191)
	Exp. Impact (S)	0.9404(±0.0328)	0.9385(±0.0315)	**0.9460(±0.0315)**	0.9297(±0.0477)	0.7144(±0.2640)
	Tgt. Aud.	0.4417(±0.1041)	0.4448(±0.1114)	**0.4530(±0.0951)**	0.4353(±0.1220)	0.3933(±0.1075)
	Instrum.	0.7144(±0.0737)	**0.7153(±0.0537)**	0.6787(±0.0333)	0.6807(±0.1059)	0.4219(±0.2092)
	Audio Eff.	0.7056(±0.1448)	**0.7275(±0.1465)**	0.7144(±0.1326)	0.7110(±0.1586)	0.5176(±0.1725)

Table 1: Evaluation results of selected music understanding models on the benchmark. The metrics of description presented in the table can be referenced to the **descriptive dimensions** of P and A on the right side of Figure 1. After encoding music by the models, we employ an MLP to output descriptive tags corresponding to these dimensions. The **pipeline** of this process can be found in Appendix H. The method for calculating the **semantic similarity** scores between the model's output results and the test set labels can be referenced in Section 4.3

truth in terms of the number of words per corresponding phrase.

- **Rhyming Fitting Accuracy.** Rhyme fitting accuracy measures the degree to which the generated lyrics match the ground truth, in terms of end-of-line rhymes.
- **Rhyming Proportion Reasonableness.** To further measure the reasonableness of rhyming, we set an additional reward score based on the proportion of rhyming sentences within the overall lyrics, to evaluate the reasonableness of the rhyming proportion in the generated lyrics.

The overall similarity is calculated by computing a weighted average, with weights of 0.10, 0.325, 0.175, 0.20, and 0.20 assigned respectively to the first five dimensions: song, section, phase, word, and rhyming fitting. Additionally, an extra weight of 0.10 is allocated to assess the reasonableness of rhyming proportions.

After comprehensive consideration, the Gestalt algorithm [Ratcliff *et al.*, 1988], which is a universal algorithm for string matching and similarity calculation, is suitable for our lyric evaluation task. Based on the Gestalt algorithm, we propose a scoring algorithm to assess the similarity between generated lyrics and actual lyrics.

The **calculation of the scores** of different dimensions is detailed in Appendix G. It mainly includes the similarity between the structures of music fragments, the similarity within music fragments.

Results

Table 2 presents the similarity scores across various dimensions for structured lyrics generated by the selected LLMs in a one-shot scenario, utilizing music descriptions as provided prompts. Notably, all models achieve commendable results. We can observe that among the base models, the overall score increases with the expansion of parameter size. Thanks to its vast parameter size and extensive training data, GPT-4 significantly outperforms the other three models across most dimensions. However, the fine-tuned Qwen, despite having fewer parameters, notably surpasses the untuned base models in overall score and demonstrates a substantial lead in every dimension. This underscores the significant impact of fine-tuning in enhancing the model's capability to comprehend music descriptions and generate structured lyrics. It also suggests considerable potential for improvement in current LLMs within the field of music, emphasizing the importance of MuChin in advancing the development of Chinese LLMs in this domain.

Model		GPT-4	GLM-4	Baichuan-2	Qwen	
					Base Model	Fine-tuned
Parameter Size		1800B	130B	53B	14B	14B
Overall Score		67.08(±6.23)	54.93(±16.46)	49.19(±15.85)	48.31(±13.39)	**85.24(±11.65)**
Structure Similarity	Song Level	2.50(±1.16)	2.29(±0.97)	2.32(±0.99)	2.58(±1.51)	**4.69(±2.38)**
	Section Level	32.40(±0.41)	28.20(±6.75)	28.83(±8.02)	26.49(±4.92)	**32.14(±0.91)**
	Phrase Level	15.52(±2.19)	12.93(±4.31)	12.74(±4.36)	11.59(±3.80)	**17.01(±0.80)**
	Word Level	0.36(±0.79)	0.15(±0.39)	0.01(±0.02)	0.10(±0.23)	**9.12(±5.92)**
Rhyming	Fitting Accuracy	13.88(±3.05)	9.61(±5.17)	4.84(±4.72)	8.01(±4.36)	**16.30(±2.94)**
	Proportion Reasonableness	2.40(±2.66)	1.74(±2.65)	0.45(±1.96)	1.29(±1.89)	**5.98(±4.03)**

Table 2: Evaluation results of the selected LLMs on the benchmark of structured lyric generation. The results are **calculated** by the **formula** detailed in Appendix G. A larger value indicates a higher degree of similarity to the corresponding dimension of the actual lyrics, signifying better quality of the generated structured lyrics. For base models, the highest score in each dimension is underlined.

4.3 Music Understanding Models

Analogous to pre-trained language models in NLP, such as BERT [Devlin *et al.*, 2019], a proficient pre-trained music understanding model should be able to effectively represent information across various dimensions within the music, allowing it to be extracted using a simple shallow neural network acting as a decoder. In our benchmark tailored for Chinese music description, we primarily evaluate the capabilities of music understanding models in music description. We select widely employed music understanding models as baselines and evaluate their performance on MuChin. The recent music understanding models include MERT-95M, MERT-330M [Li *et al.*, 2023], Jukebox-5B [Castellon *et al.*, 2021], Music2Vec [Li *et al.*, 2022] and EnCodec [Défossez *et al.*, 2022]. And considering that Jukebox-5B is a pre-trained generative model, not originally designed for music understanding, we use the method in [Castellon *et al.*, 2021] to encode audio with Jukebox-5B.

Evaluation Metrics

To assess the effectiveness of music understanding models, we feed music audio into them and obtain their respective encoded sequences. Subsequently, for each model, we utilize a classifier comprising an average pooling layer and 5 linear layers to extract 10 sets of descriptive music tags corresponding to the dimensions of its output encoded sequences.

- **Semantic Similarity Score.** The BGE model [Xiao *et al.*, 2023], as a general word vector embedding model, has demonstrated impressive performance on various tasks. We utilize the bge-large-zh-v1.5 model to calculate the semantic similarity between the generated and original tags.

For each set of test data, we can ascertain the semantic similarity between them by encoding the tags into embeddings using the BGE model and computing the outer product of these embeddings. Then we sequentially enumerate each generated tag against the original tags, calculate the Semantic Similarity Scores between them, and then obtain the average of all the values as the score of a specific model.

Results

Table 1 demonstrates the semantic similarity scores of the five selected models. It can be observed that, MERT, which encodes both audio and music attributes, performs best in understanding and describing music. Thanks to its massive number of parameters and volume of training data, Jukebox also achieves commendable results. However, as its architecture does not emphasize music attributes, its performance does not reach its full potential.

Moreover, for MERT-95M and MERT-330M, despite their scores being relatively close, we still observe the inverse-scaling effect across multiple dimensions, consistent with the phenomenon mentioned in the paper of MERT [Li *et al.*, 2023]. Specifically, for objective music attributes such as rhythm and instrumentation, MERT-330M performs better, but for most subjective descriptive dimensions, MERT-95M shows superior performance. Therefore, we hypothesize that, in line with the descriptions in the MERT paper, as the amount of data and the number of parameters increase, MERT incorporates more music attribute information, which makes it easier for the model to extract music attributes. However it may lead to a dilution of some audio description-related information. This also indicates that the music attributes extracted by MIR cannot be directly used for music description benchmarks.

5 Conclusion

In this study, we developed an annotation platform called CaiMAP to create a dataset of music descriptions in colloquial Chinese language, termed CaiMD. Leveraging these resources, we introduced the MuChin benchmark, which offers a novel perspective on the performance of language models in the realm of music. MuChin challenges models not only to provide professional-level descriptions of music but also to align with public perceptions.

Despite our efforts to make MuChin as comprehensive and inclusive as possible, it solely addresses tasks related to understanding and generating music descriptions. As such, it does not fully capture the overall capabilities of models in the field of music.

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